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PRE BRAZE INSTALLED DESICCANT ASSEMBLY FOR AUTOMOTIVE
CONDENSER WITH INTEGRAL RECEIVER

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TECHNICAL FIELD

This invention relates to condensers with integrated receivers,
and specifically to a desiccant cartridge capable of being installed in the
10 receiver prior to the condenser brazing operation.

BACKGROUND OF THE INVENTION

Certain automotive air conditioning systems use a canister like
15 reservoir container for refrigerant located downstream of the condenser,
generally referred to as a "receiver." This, as opposed to a reservoir canister
located upstream of the compressor, generally called an accumulator.
Historically, receivers have been separate canisters plumbed into the system at a
location remote from the condenser, but lately, many designs have been
20 proposed for directly structurally integrating the receiver/reservoir with the
outlet manifold tank of the condenser itself, often by co extruding the two, or
brazing them directly together when the entire condenser is brazed. This
generally creates a long, thin reservoir tank, directly adjacent to the outlet
manifold tank of the condenser.

25 An air conditioning system needs a supply of desiccant to which
the refrigerant charge is continually exposed during the life of the system in
order to pick up any traces of moisture entering the lines. The refrigerant
reservoir canisters have generally been the most convenient location for the
desiccant supply, which may be in a filter bag or cartridge somehow fixed
30 inside the canister before it is closed up. Whatever the location, it is necessary
that the desiccant material be well exposed to the refrigerant flow, but be
protected from jostling, fracture or dislodgment, so as to prevent any of the
desiccant particles from migrating through the lines and doing damage to other
parts of the system.

In the case of condensers with integral receivers, often referred to as integral RD's, existing patents show a number of variations on a common theme. Various cartridges and other assemblies are provided to allow the desiccant charge to be installed after the basic condenser/receiver structure has been run through the braze oven and substantially completed, but for the addition of one or more end caps to the integral receiver tank itself. The desiccant assembly is generally made long and thin so as to take maximum advantage of the interior size of the receiver tank while still allowing the refrigerant to rise and fall freely within. The cartridge is axially inserted post braze, and the tank end cap added last. The end cap may be threaded and removable, or welded in place. In either case, the desiccant assembly or cartridge need not tolerate any more heat than, at the most, the heat involved in brazing on the end cap itself, which is localized and rather brief. For example, co owned USPN 6170287 shows a long, thin fabric sleeve held above and away from the end cap by a plastic post or stand off, which protects the sleeve from the heat of end cap welding, and later maintains the sleeve axially, and, to an extent, radially in position during condenser operation. None of these known assemblies, however, would allow the desiccant cartridge to be installed before the condenser/receiver assembly was brazed, which involves temperatures approaching 1200 degrees F for substantially longer periods than it takes to weld on an end cap. Consequently, a post braze installation operation is a necessity, which adds cost and cycle time.

SUMMARY OF THE INVENTION

The invention discloses a desiccant cartridge structure for a condenser with integrally brazed receiver tank that allows the cartridge to be assembled and installed before the condenser braze operation. In the embodiment disclosed, the cartridge is also fixed in place within the tank by and during the braze operation itself.

In the preferred embodiment, all parts of the desiccant assembly or cartridge are initially chosen to be capable of withstanding the braze

operation temperature. These components include a long, thin heat resistant tube (preferably, a metal tube of material similar to the tank itself), filled with a heat resistant desiccant and open to refrigerant flow through a suitable heat resistant filter material and ventilated end closure. A similarly heat resistant locating and retention member serves to keep the cartridge axially and radially located within the tank interior as it is inserted within the tank, prior to the tank being closed with its end cap. The tank end cap is fixed to the tank by and during the braze operation, with no post braze operation needed, and the desiccant cartridge remains in place, without damage, during the same braze operation. In the embodiment disclosed, the locating and retention member is a crown shaped clip surrounding the cartridge tube, which not only withstands the braze operation, but takes advantage of it by fusing to the tube and tank interior so as to fix it permanently within the tank.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features of the invention will appear from the following written description, and from the drawings, in which:

Figure 1 is a schematic view of the general type of condenser and integrated receiver tank referred to above;

Figure 2 is a perspective view of the components of the desiccant cartridge disassembled;

Figure 3 is a plan view of the completed cartridge;

Figure 4 is a cross section taken along the line 4-4 of Figure 3;

Figure 5 shows the cartridge about to be inserted into the receiver tank, prior to the braze operation;

Figure 6 shows the cartridge fully inserted, with the end cap being added;

Figure 7 shows the cartridge being brazed in place inside the tank during the basic condenser brazing operation itself.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to Figure 1, a condenser 10 of the cross flow, headered type, or brazed aluminum construction. Condenser 10 has an inlet/outlet header tank 12 on one side, and a return header tank 14 on the other, each of which is divided into discrete upper (U) and lower (L) sections by separators 16 and 18 respectively. Heated, compressed refrigerant vapor enters the upper section (U) of header tank 12, above separator 16, and flows across and through the flow tubes in the main pass section (not illustrated in detail). In the main pass, refrigerant is condensed to liquid form and flows into the upper section (U) of return tank 14, above the separator 18. From there, all liquid refrigerant is forced, by the separator 18, to flow through an upper inlet 20 and into an attached reservoir or receiver tank 22, where it backs up into a reserve column of varying height. From the reserve column, liquid refrigerant can flow down and through a lower outlet 21, into lower section (L) of return tank (14) and ultimately into a sub cooler section of condenser 10, comprised of those flow tubes located below the two separators 16 and 18. In the sub cooler section, liquid refrigerant is further cooled, below the temperature necessary to simply condense it, and flows finally back into the lower section (L) of header tank 12. The desiccant containing structure of the invention, not illustrated in Figure 1, is installed within receiver tank 22, as described next. Mutually contacting surfaces of the various components of condenser 10 (tube ends to tube slots, fin surface to tube outer surface, etc) are, as is conventional, clad with a braze material of a eutectic aluminum-silicon alloy that melts at braze temperatures, is pulled by capillary action into contact interfaces, and later hardens to form structural and sealed joints.

Referring next to Figures 2 through 4, a preferred embodiment of the desiccant cartridge of the invention, referred to generally at 24, is illustrated. Cartridge assembly 24 has relatively few components, the materials for which are chosen primarily so as to be capable of withstanding the typical temperatures and times of the braze process, which can rise to around 1200 degrees F. The main component is a long, thin cylindrical tube 26, of aluminum

or other material that is heat resistant and compatible with the base material of receiver tank 22. As disclosed, tube 26 is substantially closed at the upper end and, initially, open at the lower end, with a wall thickness of approximately half a millimeter, and approximately 250 mm in length and 25 mm in diameter, so as to take maximum advantage of the axial and radial space within receiver tank 22. Tube 26 has a volume sufficient to hold a charge of approximately 70 grams of a suitable desiccant material 28 which, here, is a synthetic, crystalline, potassium sodium alumina silicate molecular sieve, often referred to simply as a synthetic zeolite. This material is suitable to the product and process disclosed in that it absorbs moisture, and also can withstand the braze temperatures described above. The desiccant material 28 is packed into the tube 26, followed by a firmly packed filter plug 30, about 25 mm thick, of a binderless felt material of the general type manufactured by Johns Mansville Co., and referred to as Micro-fiber Felt-Type E. The filter material is suitable to the task by virtue of being, again, heat resistant, and also being fine enough to retain the desiccant particles, but still porous enough to freely admit refrigerant in and out. The filter plug 30 is followed by a disk shaped aluminum screen 32, which is pressed down firmly against the filter plug 30 and then crimped in place by the bottom edge of tube 26 being formed over its outer edge. If desired, a bleed hole 34 can be added at the top of tube 26.

Still referring to Figures 4 through 6, the sub assembly of tube 26 along with desiccant 28, filter plug 30 and retention screen 32 is positioned within the receiver tank 22 before and during the braze process, as well as retained within receiver tank 22 thereafter, by a locating and retention member in the form of a crown shaped clip, indicated generally at 36. Clip 36 is also formed of a metal compatible with the receiver tank 22, with a rim 38 that fits tightly over the outside of tube 26, and a series of resilient, outwardly extending fingers 40, sized to slide along and tightly, resiliently engage the inner surface of tank 22 when inserted, as shown in Figure 6. Clip 36 locates the entire desiccant assembly 24 axially above the ports 20 and 21, as well as radially centered within the inner surface of tank 22, with approximately 3 mm radial clearance all the way around. As such, tube 26 takes maximum advantage

of the interior space within tank 22, but without blocking refrigerant flow in any direction, and without blocking the inlet and outlet 20 and 21. Clip 36 is also clad, on both surfaces, with the same kind of braze material referred to above.

Referring finally to Figures 6 and 7, after assembly 24 is
5 installed, a close fitting tank bottom end cap 42 is installed (but not otherwise attached to tank 22) and the entire assembly of condenser 10, integral tank 22 and desiccant assembly 24 is fixtured and sent through a braze oven, indicated schematically at 44. Within oven 44, all parts are heated to the braze melt
10 temperature (higher than the clad melt temperature, but significantly lower than the melt temperatures of the base components themselves). The mechanical retention force of the tight fitting clip fingers 40 within tank 22 is sufficient to keep tube 26 in place during the braze process, during which time liquid braze material runs into the interface between clip rim 38 and the outside of tube 26, as well as the interface between the tips of clip fingers 40 and the inner surface
15 of tank 22. Post braze, this solidifies to form a rigid joint between tube 26 and tank 22, just as at all other structural interfaces. As a consequence of the structural connection formed during the basic braze process, no post processing steps are needed either to install the desiccant assembly or finish the receiver tank. Thus, the method as disclosed does more than just tolerate or withstand
20 the braze process, it takes advantage of it, as well, to establish and create a structural connection. In operation, rising refrigerant flows up through screen 32, filter plug 30 and into and through the desiccant charge 28, while any displaced gas exits the bleed hole 34, reversing the process as it falls. The braze joints between clip 36, tube 26 and tank 22 are sufficient to hold up to vibration
25 and jostling during later operation of condenser 10, as much so as for any other brazed joint in the entire structure. In addition, the resilience of the clip fingers 40 helps to dampen such jostling, while the radial clearance around tube 26 should prevent it from colliding with the inside of tank 22.

Variations in the disclosed embodiment could be made. Any heat
30 resistant material for tube 26 could work, but the metal compatible with the tank 22 is preferred, because it can work with the braze process to establish structural joints, as noted. A tube 26 that was very finely meshed or ventilated could,

alone, serve to expose the desiccant charge 28 to the refrigerant inside tank 22, while still keeping the desiccant grains from sifting out. However, the filter plug 30 and screen 32 would generally be more likely to assure proper exposure and retention of the desiccant grains, especially if they were likely to pulverize partially over long use. While the structural use of the braze process is preferred, a clip like 36 could, for example, use barbs on the fingers 40 and a very tight interference on the rim 38 so as grab the inner surface of the receiver tank 22 and the outer surface of tube 26 respectively, and thereby serve to adequately locate and retain the tube 26. Such a modified clip would tolerate the braze process, and enable pre braze installation, but without participating in the braze process per se. Such mechanical force only installation would require a greater insertion force, however. Theoretically, something comparable to the stand-off post in USPN 6170287 referred to above, if made of a heat resistant material, and also designed to be fixed to the desiccant tube 26 as well as to be fixable to the interior of tank 22 in such a way as to radially and axially locate the tube 26, would work. The clip 36 disclosed is smaller and lighter, however, and, since it is fixable axially along the length of the tube 26, and radially between outside of tube 26 and inside of tank 22, is much more efficient at maintaining the axial and radial position of tube 26, both in structural terms and in terms of low weight and material cost.